0338080Z CRAWFORD CO.
ROBINSON/MARATHON
SUBJECT F

~~[illegible]~~ (MARC)/DAVE

Illinois Refining Division

Marathon Petroleum Company

Robinson, Illinois 62454
Telephone 618/544-2121

CERTIFIED MAIL - RETURN RECEIPT REQUESTED

September 15, 1983

Mr. Richard Carlson, Director
Illinois Environmental Protection Agency
2200 Churchill Road
Springfield, IL 62706

Dear Sir:

Please find attached the groundwater quality assessment program required by the Illinois Environmental Protection Agency (IEPA) in Section 725. 193(d) of the Illinois Hazardous Waste Management Regulations.

As discussed with your Mark Haney, the program was developed by Dames and Moore and outlines as a first step to reestablish groundwater background data.

If you have any questions, please contact me at (618) 544-2121, Ext. 279.

Sincerely,

David R. Saad
Environmental Coordinator

DRS:mjb

Attachment

cc: Mark Haney (IEPA)

GROUND WATER QUALITY ASSESSMENT PROGRAM
MARATHON PETROLEUM COMPANY
ROBINSON, ILLINOIS REFINERY

INTRODUCTION

This document presents the ground water quality assessment program required by the Illinois Environmental Protection Agency (IEPA) in Section 725.193(d) of the Illinois Hazardous Waste Management Regulations. A brief discussion of the chemical analysis results to date is presented in the Background section, along with an evaluation of these results. Based on this evaluation, an Assessment Program is described that is designed to allow a determination of whether or not hazardous waste or hazardous waste constituents from the facility have entered the ground water.

BACKGROUND

A ground water monitoring system was installed around the land-based hazardous waste facilities (one land treatment area, two small surface impoundments and one waste pile pad) at Marathon Petroleum Company's Robinson, Illinois refinery in early November 1981, in accordance with the requirements of Section 725.191. Ground water samples were collected and analyzed for the parameters and at the time intervals required in Section 725.192.

Statistical comparisons performed on ground water samples taken after the first year's sampling showed statistically significant increases in the concentrations of contamination indicator parameters over initial background levels established during the first year's quarterly sampling and analyses (see Appendix). In addition, resampling and analysis of additional ground water samples from these wells, as required in Section 725.193(c)(2), also showed a significant difference.

However, in examining the chemistry data in detail, it appears that the statistical increases may be due in large part to inconsistent data rather than hazardous waste constituents entering the ground water from the facility. For instance, in addition to the downgradient wells showing a significant increase from background, the upgradient well (B-2) also showed a significant increase over background for pH, TOX, and TOC. In addition, the values for pH, TOX, and TOC show a general dramatic increase over background levels for nearly all wells in the two samplings taken after background was established. Calculations were made to determine if a contaminant plume from outside the area could have entered the monitoring area to cause the increase. However, ground water velocities at the site are much too slow, and the distances between wells too great, to cause the sudden changes noted in all the wells.

Other apparent anomalies in the data are the extremely low concentrations of TOC and TOX noted in the November 1982 sampling, which was the last quarterly sample used to establish background. The sudden drastic decrease in these constituents for this sampling suggests a problem with sample handling, preservation, or analysis. These low concentrations also tend to produce unrealistically low mean background concentrations for these parameters.

It appears that the temporal variations in concentrations of the indicator parameters between the quarterly samples taken in 1982 and the comparative samples taken in 1983 at any one point are greater than the upgradient versus downgradient concentrations at a particular point in time. In fact, the highest concentration of TOX in the most recent sampling was detected in the upgradient well.

The concentrations of the drinking water parameters were generally found to be below the limits specified in the National Interim Primary Drinking Water Standards. The exceptions to this were slightly elevated concentrations of selenium and mercury in an upgradient well and selenium in one downgradient well in the first quarterly sampling. These appear to be anomalous, because all later results showed these parameters to have concentrations below the drinking water standards in all wells. Nitrates in the upgradient well have usually been above the standard, and these elevated concentrations have been attributed to nitrogen fertilizers applied to adjacent farmland. Nitrate concentrations in all downgradient wells have remained below the standards.

The results of the unsaturated zone pore water and soil core sampling in the land treatment area seem to indicate that there is little or no vertical migration of hazardous waste constituents through the soils. Concentrations of tested chemical constituents from sampling points within the land treatment area are generally in the same range as those from background sampling points outside the land treatment area.

In conjunction with the other apparent data problems discussed above, it appears that much of the reason for failure of the statistical test is due to poor chemical data that may be a result of inconsistent or improper sample collection, handling, preservation, or analysis. However, sample collection, handling, and preservation procedures have remained generally constant and were performed under the guidance of one individual. In contrast, chemical testing laboratories were changed after the third quarterly background sampling, and it appears likely that a substantial portion of the sudden changes in concentrations of indicator parameters could be due to the change in testing laboratories. This contention is supported by the fact that analyses performed on splits of the same sample by different laboratories usually produced widely divergent results.

It should be noted that former upgradient monitoring well B-3 has been eliminated from the monitoring program. Detailed analysis of ground water flow at the site indicates that B-3 may be downgradient at certain times of the year due to minor fluctuations in flow direction. The B-3 chemical results have also been eliminated from the statistical comparison tests.

ASSESSMENT PROGRAM

The following assessment program is designed to determine if the failure of the statistical comparison specified in Section 725.193(d) is due to hazardous waste constituents entering the ground water system at the facility or is a result of problems with sample collection, preservation, or analysis. The components of the assessment program will be performed sequentially as follows:

A. (1) Review and revise, if necessary, sample collection, preservation, and shipment procedures to comply with those stated in Section 725.192(a).

(2) Reestablish background levels of all parameters specified in Section 725.192(b) in the amounts and frequencies specified in Section 725.192(c), and make the statistical comparisons specified in Section 725.193(b) for the fifth sampling.

B. (1) If the chemical analyses performed in A do not indicate significant degradation of downgradient water quality, continue the normal sampling and analysis program specified in Section 725.192.

(2) If the results of the additional sampling performed in A indicate possible degradation of downgradient water quality, then resample all the wells, split the samples in four, and obtain four replicate measurements of each contaminant indicator parameter. Perform the test specified in Section 725.193(b) to statistically compare each well with the upgradient well.

C. (1) If the chemical analyses performed in B(2) do not indicate significant degradation of downgradient water quality, continue the normal sampling and analysis program specified in Section 725.192.

(2) If the chemical analyses performed in B(2) indicate possible degradation of downgradient water quality, perform applicable priority pollutant analyses on samples from each well to define the particular chemical constituents and their concentrations that caused the apparent increases in concentrations of the contamination indicator parameters. Review the priority pollutant analyses in light of hazardous waste test data collected for the facility to identify specific parameters that may be causing contamination.

D. (1) If the analyses, review, and tests performed in B and C above indicate that the concentration increases are not related to the facility, reinstate the normal monitoring program once the background levels have been reestablished as stated in A(2).

(2) If it is determined that the increases are related to the facility, additional assessments of ground water will be made as required in Section 725.193(d)(3) and (4).

—ooOoo—

It has been a pleasure to prepare this assessment program for you. If you have any questions, please feel free to call.

Respectfully submitted,

DAMES & MOORE

Dayal Saran

Dayal Saran
Associate

Steven L. Martin
Hydrogeologist

DS/SLM:lhk

ETC ENVIRONMENTAL TESTING and CERTIFICATION

APPENDIX

DATA MANAGEMENT STATUS REPORT

For

Marathon Petroleum Company
Robinson, Illinois

August, 1983

Data Management Status Report

Index

DM-20
Facility/Sample Point Log

ETC ENVIRONMENTAL TESTING and CERTIFICATION

DATA MANAGEMENT SUMMARY REPORT
Facility/Sample Point Log (DM-20)

THU, AUG 25, 1983, 12:45 PM

Bill To Account	Facility	SRC Sample Point	Date	Time	Elapsed Time	ETC Sample Number	ETC Status	Order Date	Chain of Custody CC1	Chain of Custody CC2	Sample Point Verification	OSPR
1448803	MPCROBGWM	WB1-D	82/03/01			U0633	INVC	83/04/06	N	N		1111
1448803	MPCROBGWM	WB1-D	82/05/10			U0634	INVC	83/04/06	N	N		1111
1448803	MPCROBGWM	WB1-D	82/07/19			U0635	INVC	83/04/06	N	N		1111
1448803	MPCROBGWM	WB1-D	82/11/09	7:00		B5821	INVC	82/11/04	Y	Y		1111
1448803	MPCROBGWM	WB1-D	83/04/18	14:15		C0822	INVC	83/03/31	Y	Y		1111
1448803	MPCROBGWM	WB1-D	83/06/20	8:00		C4573	INVC	83/06/10	Y	Y		1111
1448803	MPCROBGWM	WB2-U	82/03/01			U0636	INVC	83/04/06	N	N		1111
1448803	MPCROBGWM	WB2-U	82/05/10			U0637	INVC	83/04/06	N	N		1111
1448803	MPCROBGWM	WB2-U	82/07/19			U0638	INVC	83/04/06	N	N		1111
1448803	MPCROBGWM	WB2-U	82/11/09	7:00		B5823	INVC	82/11/04	Y	Y		1111
1448803	MPCROBGWM	WB2-U	83/04/18	10:45		C0823	INVC	83/03/31	Y	Y		1111
1448803	MPCROBGWM	WB2-U	83/06/20	8:00		C4574	INVC	83/06/10	Y	Y		1111
1448803	MPCROBGWM	WB3-U	82/05/10			U0639	INVC	83/04/06	N	N		1111
1448803	MPCROBGWM	WB3-U	82/07/19			U0640	INVC	83/04/06	N	N		1111
1448803	MPCROBGWM	WB3-U	82/11/09	7:00		B5819	INVC	82/11/04	Y	Y		1111
1448803	MPCROBGWM	WB3-U	83/04/18	11:00		C0824	INVC	83/03/31	Y	Y		1111
1448803	MPCROBGWM	WB3-U	83/06/20	8:00		C4575	INVC	83/06/10	Y	Y		1111
1448803	MPCROBGWM	WB4-D	82/03/01			U0641	INVC	83/04/06	N	N		1111
1448803	MPCROBGWM	WB4-D	82/05/10			U0642	INVC	83/04/06	N	N		1111
1448803	MPCROBGWM	WB4-D	82/07/19			U0643	INVC	83/04/06	N	N		1111
1448803	MPCROBGWM	WB4-D	82/11/09	7:00		B5822	INVC	82/11/04	Y	Y		1111
1448803	MPCROBGWM	WB4-D	83/04/18	13:30		C0825	INVC	83/03/31	Y	Y		1111
1448803	MPCROBGWM	WB4-D	83/06/20	8:00		C4577	INVC	83/06/10	Y	Y		1111
1448803	MPCROBGWM	WN1-D	82/03/01			U0644	INVC	83/04/06	N	N		1111
1448803	MPCROBGWM	WN1-D	82/05/10			U0645	INVC	83/04/06	N	N		1111
1448803	MPCROBGWM	WN1-D	82/07/19			U0646	INVC	83/04/06	N	N		1111
1448803	MPCROBGWM	WN1-D	82/11/09	7:00		B5820	INVC	82/11/04	Y	Y		1111
1448803	MPCROBGWM	WN1-D	83/04/18	13:45		C0826	INVC	83/03/31	Y	Y		1111
1448803	MPCROBGWM	WN1-D	83/06/20	8:00		C4576	INVC	83/06/10	Y	Y		1111
1448803	MPCROBGWM	WN2-D	82/03/01			U0647	INVC	83/04/06	N	N		1111
1448803	MPCROBGWM	WN2-D	82/05/10			U0648	INVC	83/04/06	N	N		1111
1448803	MPCROBGWM	WN2-D	82/07/19			U0649	INVC	83/04/06	N	N		1111
1448803	MPCROBGWM	WN2-D	82/11/09	7:00		B5824	INVC	82/11/04	Y	Y		1111
1448803	MPCROBGWM	WN2-D	83/04/18	14:00		C0827	INVC	83/03/31	Y	Y		1111
1448803	MPCROBGWM	WN2-D	83/06/20	8:00		C4578	INVC	83/06/10	Y	Y		1111

Client Reviewer: _____

Date: _____

ETC Reviewer: _____

Date: _____

ETC ENVIRONMENTAL TESTING and CERTIFICATION

Data Management Reports

DM-1C

ETC ENVIRONMENTAL TESTING and CERTIFICATION

DATA MANAGEMENT SUMMARY REPORT
(DM-1C) – All Parameters Present, Selected Samples

August 18, 1983
Page 1

Chain of Custody Data Required for ETC Data Management Summary Report

See Below	MARATHON PETROLEUM COMPANY	MPCROBGAM	See Below	
ETC Sample No.	*Company*	*Facility*	*Sample Point*	*Date*

Parameters	*Units*	*Sample Points, Sampling Dates, and ETC Sample No.'s*							
		W B1-D 830620 C4573	W B2-U 830620 C4574	W B3-U 830620 C4575	W B4-D 830620 C4577	W N1-D 830620 C4576	W N2-D 830620 C4578		
GW Conventionals									
Chloride	mg/l	9.31	4.66	28	0.76	22.8	5.67		
Total Organic Halides (TOX)	ug/l	44.4	62	30	28	43	20.5		
Total Organic Halides (TOX)	ug/l	31.4	53	40	26.2	44	19.5		
Total Organic Halides (TOX)	ug/l	38.7	87	48	24.9	29	21.1		
Total Organic Halides (TOX)	ug/l	30.3	72	39	24.3	37	22.2		
Total Organic Carbon	mg/l	74	54	23	86	94	76		
Total Organic Carbon	mg/l	72	54	22	84	93	75		
Total Organic Carbon	mg/l	73	54	22	84	93	75		
Total Organic Carbon	mg/l	73	54	22	79	93	75		
Specific Conductance	um/cm	530	410	410	550	700	520		
Specific Conductance	um/cm	530	410	410	560	700	520		
Specific Conductance	um/cm	530	410	420	560	710	530		
Specific Conductance	um/cm	530	410	420	570	710	530		
pH	std	7.1	7.5	7.8	7.8	7.6	7.4		
pH	std	7.1	7.5	7.8	7.8	7.6	7.4		
pH	std	7.1	7.5	7.8	7.8	7.6	7.4		
pH	std	7.1	7.5	7.8	7.8	7.6	7.4		

Notes: BMDL=Below Method Detection Limit ND=Parameter not detected "-"=Parameter not tested

DM-1H

ETC ENVIRONMENTAL TESTING and CERTIFICATION

DATA MANAGEMENT SUMMARY REPORT
(DM-1H) - History of All Parameters Present, Selected Sample Point

August 18, 1983
Page 1

Chain of Custody Data Required for ETC Data Management Summary Report

See Below	MARATHON PETROLEUM COMPANY	MPCROBGWM	W B1-D	See Below
ETC Sample No.	*Company*	*Facility*	*Sample Point*	*Date*

Parameters	*Units*	*Sample Points, Sampling Dates, and ETC Sample No.'s*							
		W B1-D 820301 U0633	W B1-D 820510 U0634	W B1-D 820719 U0635	W B1-D 821109 B5821	W B1-D 830418 C0822	W B1-D 830620 C4573		
GW Met., Pest., & Herb.									
Barium	ug/l	100	<30	<50	20	-	-		
Cadmium	ug/l	2.5	5	5	ND	-	-		
Chromium	ug/l	<50	2.6	2.5	ND	-	-		
Lead	ug/l	4	9	9	BMDL	-	-		
Mercury	ug/l	<0.1	0.4	<0.3	BMDL	-	-		
Selenium	ug/l	4	<3	<3	ND	-	-		
Iron	ug/l	<50	<1.8	5	BMDL	ND	-		
Manganese	ug/l	380	220	201	200	120	-		
Sodium	ug/l	40700	39200	38500	41000	40000	-		
GW Conventionals									
Chloride	mg/l	13	4	10	69.8	9.4	9.31		
Fluoride	mg/l	0.1	0.26	0.11	0.15	-	-		
Nitrate as N	mg/l	3.1	1.8	4.6	0.32	-	-		
Sulfate as S04	mg/l	13	12	9	<9	<9	-		
Total Organic Halides (TOX)	ug/l	14	36	23	27.9	83.9	44.4		
Total Organic Halides (TOX)	ug/l	ND	28	28	22.3	79.4	31.4		
Total Organic Halides (TOX)	ug/l	ND	37	24	-	80.8	38.7		
Total Organic Halides (TOX)	ug/l	13	ND	24	-	81.2	30.3		
Total Organic Carbon	mg/l	10.3	9.6	50.6	1.3	71	74		
Total Organic Carbon	mg/l	9.6	11.3	49.4	1.3	69	72		
Total Organic Carbon	mg/l	9.3	9.5	49.5	-	69	73		
Total Organic Carbon	mg/l	9.9	10.6	46.5	-	70	73		
Specific Conductance	um/cm	490	407	489	541	456	530		
Specific Conductance	um/cm	487	415	498	-	456	530		
Specific Conductance	um/cm	500	420	495	-	455	530		
Specific Conductance	um/cm	501	421	498	-	456	530		
pH	std	7.91	7.9	7.48	7.6	7.3	7.1		
pH	std	7.95	7.87	7.59	-	7.3	7.1		
pH	std	7.95	7.87	7.59	-	7.3	7.1		
pH	std	7.96	7.86	7.54	-	7.3	7.1		
Gross Alpha	pCi/l	2.2	4	3	<2	-	-		
Gross Alpha	pCi/l	+/-2.3	+/-4	+/-4	-	-	-		

Footnotes: BMDL=Below Method Detection Limit ND=Parameter not detected '-'=Parameter not tested

ETC ENVIRONMENTAL TESTING and CERTIFICATION

DATA MANAGEMENT SUMMARY REPORT
(DM-1H) - History of All Parameters Present, Selected Sample Point

Chain of Custody Data Required for ETC Data Management Summary Report

See Below	MARATHON PETROLEUM COMPANY	MPCROBGUM	W B1-D	See Below
ETC Sample No.	*Company*	*Facility*	*Sample Point*	*Date*

Parameters	*Units*	*Sample Points, Sampling Dates, and ETC Sample No.'s*							
		W B1-D 820301 U0633	W B1-D 820510 U0634	W B1-D 820719 U0635	W B1-D 821109 B5821	W B1-D 830418 C0822	W B1-D 830620 C4573		
Gross Beta	pCi/l	3.9	3	4	<4	-	-		
Gross Beta	pCi/l	+/-5.8	+/-4	+/-5	-	-	-		
Miscellaneous Parameters									
Radium 226	pCi/l	0.2	0.1	-.2	-	-	-		
Radium 226	pCi/l	+/-0.6	+/-0.3	+/-0.7	-	-	-		
Radium 228	pCi/l	0	0.4	2.4	-	-	-		
Radium 228	pCi/l	+/-5.7	+/-1.2	+/-1.3	-	-	-		
Temperature	Deg. C	11.7	12.8	15.6	15.6	-	-		

Footnotes: BMDL=Below Method Detection Limit ND=Parameter not detected '-'=Parameter not tested

ETC ENVIRONMENTAL TESTING and CERTIFICATION

DATA MANAGEMENT SUMMARY REPORT
(DM-1H) - History of All Parameters Present, Selected Sample Point

Chain of Custody Data Required for ETC Data Management Summary Report

See Below	MARATHON PETROLEUM COMPANY	MPCROBGWM	W B2-U	See Below
ETC Sample No.	*Company*	*Facility*	*Sample Point*	*Date*

Parameters	*Units*	*Sample Points, Sampling Dates, and ETC Sample No.'s*							
		W B2-U 820301 U0636	W B2-U 820510 U0637	W B2-U 820719 U0638	W B2-U 821109 B5823	W B2-U 830418 C0823	W B2-U 830620 C4574		
GW Met., Pest., & Herb.									
Barium	ug/l	120	<30	<50	40	-	-		
Cadmium	ug/l	<8.8	<1	1	ND	-	-		
Chromium	ug/l	<50	2.5	2.7	ND	-	-		
Lead	ug/l	49	9	9	BMDL	-	-		
Mercury	ug/l	2.1	0.7	<0.3	ND	-	-		
Selenium	ug/l	12	<3	<3	ND	-	-		
Iron	ug/l	<50	<1.8	3	BMDL	ND	-		
Manganese	ug/l	<50	<10	4	ND	20	-		
Sodium	ug/l	41000	38900	40300	42000	48000	-		
GW Conventionals									
Chloride	mg/l	33	15	34	98.5	113	4.66		
Fluoride	mg/l	0.17	0.28	<0.1	0.12	-	-		
Nitrate as N	mg/l	23.6	27	27.8	10.7	-	-		
Sulfate as S04	mg/l	2	5	0.5	<9	<9	-		
Total Organic Halides (TOX)	ug/l	44	43	41	16.2	49.5	62		
Total Organic Halides (TOX)	ug/l	39	35	40	19.6	57.6	53		
Total Organic Halides (TOX)	ug/l	55	31	42	-	53.7	87		
Total Organic Halides (TOX)	ug/l	53	40	41	-	53.3	72		
Total Organic Carbon	mg/l	15.2	5.7	23.7	1.8	28	54		
Total Organic Carbon	mg/l	15.4	6.4	23.4	1.8	32	54		
Total Organic Carbon	mg/l	13.3	6.4	21.7	-	31	54		
Total Organic Carbon	mg/l	13.5	7.8	20	-	32	54		
Specific Conductance	um/cm	356	433	481	.413	420	410		
Specific Conductance	um/cm	355	434	481	-	420	410		
Specific Conductance	um/cm	355	427	483	-	420	410		
Specific Conductance	um/cm	356	435	480	-	419	410		
pH	std	8.19	8.12	8.13	7.8	7.6	7.5		
pH	std	8.2	8.17	8.07	-	7.6	7.5		
pH	std	8.2	8.15	8.08	-	7.6	7.5		
pH	std	8.1	8.18	8.04	-	7.6	7.5		
Gross Alpha	pCi/l	1	0	0	<2	-	-		
Gross Alpha	pCi/l	+/-1.6	+/-2	+/-3	-	-	-		

Footnotes: BMDL=Below Method Detection Limit ND=Parameter not detected '-'=Parameter not tested

ETC ENVIRONMENTAL TESTING and CERTIFICATION

DATA MANAGEMENT SUMMARY REPORT
(DM-1H) - History of All Parameters Present, Selected Sample Point

Chain of Custody Data Required for ETC Data Management Summary Report

See Below	MARATHON PETROLEUM COMPANY	MPCROBGWM	W B2-U	See Below
ETC Sample No.	*Company*	*Facility*	*Sample Point*	*Date*

Parameters	Units	Sample Points, Sampling Dates, and ETC Sample No.'s							
		W B2-U 820301 U0636	W B2-U 820510 U0637	W B2-U 820719 U0638	W B2-U 821109 B5823	W B2-U 830418 C0823	W B2-U 830620 C4574		
Gross Beta	pCi/l	15	20	0	<4	-	-		
Gross Beta	pCi/l	+/-0.7	+/-4	+/-5	-	-	-		
Miscellaneous Parameters									
Radium 226	pCi/l	0	0.1	-.2	-	-	-		
Radium 226	pCi/l	+/-0.7	+/-0.7	+/-0.7	-	-	-		
Radium 228	pCi/l	0	-.5	2.4	-	-	-		
Radium 228	pCi/l	+/-6.5	+/-1.1	+/-1.3	-	-	-		
Temperature	Deg. C	11.1	12.8	14.4	15.6	-	-		

Notes: BMDL=Below Method Detection Limit ND=Parameter not detected '-'=Parameter not tested

ETC ENVIRONMENTAL TESTING and CERTIFICATION

DATA MANAGEMENT SUMMARY REPORT
(DM-1H) - History of All Parameters Present, Selected Sample Point

August 19, 1983
Page 1

Chain of Custody Data Required for ETC Data Management Summary Report

See Below	MARATHON PETROLEUM COMPANY	MPCROBGWM	W B3-U	See Below
ETC Sample No.	*Company*	*Facility*	*Sample Point*	*Date*

Parameters	*Units*	*Sample Points, Sampling Dates, and ETC Sample No.'s*							
		W B3-U 820510 U0639	W B3-U 820719 U0640	W B3-U 821109 B5819	W B3-U 830418 C0824	W B3-U 830620 C4575			
GW Met., Pest., & Herb.									
Barium	ug/l	<30	<50	40	-	-			
Cadmium	ug/l	2	3	ND	-	-			
Chromium	ug/l	2.3	1.6	ND	-	-			
Lead	ug/l	9	9	BMDL	-	-			
Mercury	ug/l	1.3	<0.3	ND	-	-			
Iron	ug/l	<1.8	14	BMDL	ND	-			
Manganese	ug/l	<10	30	15	20	-			
Sodium	ug/l	45800	52500	49000	45000	-			
GW Conventionals									
Chloride	mg/l	3	4	60.3	5.5	28			
Fluoride	mg/l	0.48	0.32	0.38	-	-			
Nitrate as N	mg/l	8.4	7.4	2.42	-	-			
Sulfate as S04	mg/l	8	11	<9	<9	-			
Total Organic Halides (TOX)	ug/l	25	23	52.2	50.9	30			
Total Organic Halides (TOX)	ug/l	22	26	54.4	50.2	40			
Total Organic Halides (TOX)	ug/l	24	29	49.8	53	48			
Total Organic Halides (TOX)	ug/l	15	27	51	51.8	39			
Total Organic Carbon	mg/l	9.8	28.7	44	46	23			
Total Organic Carbon	mg/l	7.1	25.9	43	42	22			
Total Organic Carbon	mg/l	7.8	26.4	33	41	22			
Total Organic Carbon	mg/l	5.9	25.3	-	41	22			
Specific Conductance	um/cm	431	345	409	398	410			
Specific Conductance	um/cm	430	348	413	396	410			
Specific Conductance	um/cm	432	347	414	401	420			
Specific Conductance	um/cm	435	350	415	412	420			
pH	std	8.17	8.14	8.1	7.4	7.8			
pH	std	8.23	8.26	8.1	7.4	7.8			
pH	std	8.22	8.24	8.1	7.4	7.8			
pH	std	8.23	8.22	8.1	7.4	7.8			
Gross Alpha	pCi/l	-1	4	<2	-	-			
Gross Alpha	pCi/l	+/-2	+/-4	-	-	-			
Gross Beta	pCi/l	1	4	14	-	-			
Gross Beta	pCi/l	+/-3	+/-5	+/-3	-	-			

Footnotes: BMDL=Below Method Detection Limit ND=Parameter not detected '-'=Parameter not tested

ETC ENVIRONMENTAL TESTING and CERTIFICATION

DATA MANAGEMENT SUMMARY REPORT
(DM-1H) - History of All Parameters Present, Selected Sample Point

Chain of Custody Data Required for ETC Data Management Summary Report

See Below	MARATHON PETROLEUM COMPANY	MPCROBGWM	W B3-U	See Below
ETC Sample No.	*Company*	*Facility*	*Sample Point*	*Date*

Parameters	*Units*	*Sample Points, Sampling Dates, and ETC Sample No.'s*							
		W B3-U 820510 U0639	W B3-U 820719 U0640	W B3-U 821109 B5819	W B3-U 830418 C0824	W B3-U 830620 C4575			
Miscellaneous Parameters									
Radium 226	pCi/l	0.1	-.2	-	-	-			
Radium 226	pCi/l	+/-0.3	+/-0.7	-	-	-			
Radium 228	pCi/l	-.4	0.7	-	-	-			
Radium 228	pCi/l	+/-1.2	+/-1.3	-	-	-			
Temperature	Deg. C	13.9	15.6	16.1	-	-			

Footnotes: BMDL=Below Method Detection Limit ND=Parameter not detected '-'=Parameter not tested

ETC ENVIRONMENTAL TESTING and CERTIFICATION

DATA MANAGEMENT SUMMARY REPORT
(DM-1H) - History of All Parameters Present, Selected Sample Point

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Chain of Custody Data Required for ETC Data Management Summary Report

See Below	MARATHON PETROLEUM COMPANY	MPCROBGWM	W B4-D	See Below
ETC Sample No.	*Company*	*Facility*	*Sample Point*	*Date*

Parameters	*Units*	*Sample Points, Sampling Dates, and ETC Sample No.'s*							
		W B4-D 820301 U0641	W B4-D 820510 U0642	W B4-D 820719 U0643	W B4-D 821109 B5822	W B4-D 830418 C0825	W B4-D 830620 C4577		
GW Met., Pest., & Herb.									
Barium	ug/l	120	<30	<50	45	-	-		
Cadmium	ug/l	<4.4	<1	5	ND	-	-		
Chromium	ug/l	<50	2.3	1.5	ND	-	-		
Lead	ug/l	16	8	9	12	-	-		
Selenium	ug/l	15	<3	<3	ND	-	-		
Iron	ug/l	<50	2	15	BMDL	ND	-		
Manganese	ug/l	340	660	749	1400	1300	-		
Sodium	ug/l	60000	49000	36700	37000	31000	-		
GW Conventionals									
Chloride	mg/l	13	3	4	75.9	1.6	0.76		
Fluoride	mg/l	0.16	0.45	0.25	0.34	-	-		
Nitrate as N	mg/l	3.1	2.2	2.6	<0.04	-	-		
Sulfate as SO4	mg/l	26	28	175	18	<9	-		
Phenolics, Total	mg/l	0.007	0.003	0.002	<0.05	<0.5	-		
Total Organic Halides (TOX)	ug/l	22	ND	41	18.9	23.4	28		
Total Organic Halides (TOX)	ug/l	24	ND	44	22.1	23.1	26.2		
Total Organic Halides (TOX)	ug/l	22	19	41	-	29.8	24.9		
Total Organic Halides (TOX)	ug/l	25	ND	36	-	31.7	24.3		
Total Organic Carbon	mg/l	16.2	26	42.1	4.9	63	86		
Total Organic Carbon	mg/l	12.2	23.9	35.4	5	58	84		
Total Organic Carbon	mg/l	12.2	27.6	32.4	-	62	84		
Total Organic Carbon	mg/l	14.2	25.3	37.5	-	54	79		
Specific Conductance	um/cm	466	533	826	5.77	552	550		
Specific Conductance	um/cm	466	541	830	-	554	560		
Specific Conductance	um/cm	474	531	831	-	565	560		
Specific Conductance	um/cm	474	542	828	-	564	570		
pH	std	8.41	7.74	8.13	7.9	7.3	7.8		
pH	std	8.43	7.79	8.22	-	7.3	7.8		
pH	std	8.46	7.81	8.23	-	7.3	7.8		
pH	std	8.46	7.82	8.21	-	7.3	7.8		
Gross Alpha	pCi/l	2	2	5	<4	-	-		
Gross Alpha	pCi/l	+/-2	+/-3	+/-5	-	-	-		

Footnotes: BMDL=Below Method Detection Limit ND=Parameter not detected '-'=Parameter not tested

ETC ENVIRONMENTAL TESTING and CERTIFICATION

DATA MANAGEMENT SUMMARY REPORT
(DM-1H) - History of All Parameters Present, Selected Sample Point

Chain of Custody Data Required for ETC Data Management Summary Report

See Below	MARATHON PETROLEUM COMPANY	MPCROBGWM	W B4-D	See Below
ETC Sample No.	*Company*	*Facility*	*Sample Point*	*Date*

Parameters	*Units*	*Sample Points, Sampling Dates, and ETC Sample No.'s*							
		W B4-D 820301 U0641	W B4-D 820510 U0642	W B4-D 820719 U0643	W B4-D 821109 B5822	W B4-D 830418 C0825	W B4-D 830620 C4577		
Gross Beta	pCi/l	2.9	-2	3	<3	-	-		
Gross Beta	pCi/l	+/-5.7	+/-3	+/-6	-	-	-		
Miscellaneous Parameters									
Radium 226	pCi/l	0.4	1.5	0.6	-	-	-		
Radium 226	pCi/l	+/-0.7	+/-1	+/-1	-	-	-		
Radium 228	pCi/l	0	0	0.4	-	-	-		
Radium 228	pCi/l	+/-8.5	+/-1.2	+/-1.2	-	-	-		
Temperature	Deg. C	11.1	15	15	14.4	-	-		

Footnotes: BMDL=Below Method Detection Limit ND=Parameter not detected '-'=Parameter not tested

ETC ENVIRONMENTAL TESTING and CERTIFICATION

DATA MANAGEMENT SUMMARY REPORT
(DM-1H) - History of All Parameters Present, Selected Sample Point

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Chain of Custody Data Required for ETC Data Management Summary Report

See Below	MARATHON PETROLEUM COMPANY	MPCROBGWM	W N1-D	See Below
ETC Sample No.	*Company*	*Facility*	*Sample Point*	*Date*

Parameters	*Units*	*Sample Points, Sampling Dates, and ETC Sample No.'s*							
		W N1-D 820301 U0644	W N1-D 820510 U0645	W N1-D 820719 U0646	W N1-D 821109 B5820	W N1-D 830418 C0826	W N1-D 830620 C4576		
GW Met., Pest., & Herb.									
Barium	ug/l	170	<30	<50	45	-	-		
Cadmium	ug/l	3.6	<1	5	ND	-	-		
Chromium	ug/l	<50	3	3.1	ND	-	-		
Lead	ug/l	6	7	8	BMDL	-	-		
Mercury	ug/l	0.2	<0.3	<0.3	BMDL	-	-		
Selenium	ug/l	2	<3	<3	ND	-	-		
Iron	ug/l	<50	9.5	5	BMDL	ND	-		
Manganese	ug/l	300	350	278	470	70	-		
Sodium	ug/l	26300	35900	32000	30000	35000	-		
GW Conventionals									
Chloride	mg/l	13	12	24	107	34	22.8		
Fluoride	mg/l	0.2	0.38	0.18	0.28	-	-		
Nitrate as N	mg/l	5.3	2.2	3.6	<0.04	-	-		
Sulfate as S04	mg/l	14	32	21	14	16	-		
Total Organic Halides (TOX)	ug/l	17	13	9.2	22.1	20.5	43		
Total Organic Halides (TOX)	ug/l	19	ND	18	20	27.4	44		
Total Organic Halides (TOX)	ug/l	17	ND	8.8	21.6	29.3	29		
Total Organic Halides (TOX)	ug/l	22	ND	12	22.8	26	37		
Total Organic Carbon	mg/l	10	10.5	10.6	1.3	80	94		
Total Organic Carbon	mg/l	8.1	10.1	10.7	1.4	88	93		
Total Organic Carbon	mg/l	9	9.9	11.2	1.3	79	93		
Total Organic Carbon	mg/l	9.2	9.3	9	1.1	70	93		
Specific Conductance	um/cm	526	694	622	590	725	700		
Specific Conductance	um/cm	528	690	621	599	727	700		
Specific Conductance	um/cm	525	694	622	588	741	710		
Specific Conductance	um/cm	526	690	619	597	737	710		
pH	std	8.17	7.9	7.88	8	7.2	7.6		
pH	std	8.2	7.88	7.9	8	7.2	7.6		
pH	std	8.2	7.96	7.88	8	7.3	7.6		
pH	std	8.21	7.97	7.93	8	7.3	7.6		
Gross Alpha	pCi/l	3	-6	4	<2	-	-		
Gross Alpha	pCi/l	+/-2.5	+/-8	+/-4	-	-	-		

Footnotes: BMDL=Below Method Detection Limit ND=Parameter not detected '-'=Parameter not tested

ETC ENVIRONMENTAL TESTING and CERTIFICATION

DATA MANAGEMENT SUMMARY REPORT
(DM-1H) - History of All Parameters Present, Selected Sample Point

Chain of Custody Data Required for ETC Data Management Summary Report

See Below	MARATHON PETROLEUM COMPANY	MPCROBGWM	W N1-D	See Below
ETC Sample No.	*Company*	*Facility*	*Sample Point*	*Date*

Parameters	*Units*	*Sample Points, Sampling Dates, and ETC Sample No.'s*							
		W N1-D 820301 U0644	W N1-D 820510 U0645	W N1-D 820719 U0646	W N1-D 821109 B5820	W N1-D 830418 C0826	W N1-D 830620 C4576		
Gross Beta	pCi/l	1.5	-13	6	9.9	-	-		
Gross Beta	pCi/l	+/-5.7	+/-15	+/-6	+/-3.1	-	-		
Miscellaneous Parameters									
Radium 226	pCi/l	0	-.1	0.5	-	-	-		
Radium 226	pCi/l	+/-0.7	+/-0.3	+/-0.9	-	-	-		
Radium 228	pCi/l	0	0.5	0.9	-	-	-		
Radium 228	pCi/l	+/-7.9	+/-1.1	+/-1.3	-	-	-		
Temperature	Deg. C	12.2	12.8	17.8	16.1	-	-		

Footnotes: BMDL=Below Method Detection Limit ND=Parameter not detected '-'=Parameter not tested

ETC ENVIRONMENTAL TESTING and CERTIFICATION

DATA MANAGEMENT SUMMARY REPORT
(DM-1H) - History of All Parameters Present, Selected Sample Point

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Chain of Custody Data Required for ETC Data Management Summary Report

See Below	MARATHON PETROLEUM COMPANY	MPCROBGMM	W N2-D	See Below
ETC Sample No.	*Company*	*Facility*	*Sample Point*	*Date*

Parameters	*Units*	*Sample Points, Sampling Dates, and ETC Sample No.'s*							
		W N2-D 820301 U0647	W N2-D 820510 U0648	W N2-D 820719 U0649	W N2-D 821109 B5824	W N2-D 830418 C0827	W N2-D 830620 C4578		
GW Met., Pest., & Herb.									
Barium	ug/l	200	<30	<50	75	-	-		
Cadmium	ug/l	5	3	4	BMDL	-	-		
Chromium	ug/l	<50	4.3	3.1	ND	-	-		
Lead	ug/l	15	8	7	13	-	-		
Selenium	ug/l	8	<3	<3	ND	-	-		
Iron	ug/l	<50	<1.8	3	BMDL	BMDL	-		
Manganese	ug/l	550	400	462	500	460	-		
Sodium	ug/l	41700	39200	40300	42000	40000	-		
GW Conventionals									
Chloride	mg/l	6	2	6	70.2	7	5.67		
Fluoride	mg/l	0.1	0.31	<1	0.14	-	-		
Nitrate as N	mg/l	2	2.2	2.6	<0.04	-	-		
Sulfate as S04	mg/l	13	12	12	<9	16	-		
Phenolics, Total	mg/l	0.005	<0.002	<0.002	<0.05	<0.05	-		
Total Organic Halides (TOX)	ug/l	28	24	15	19	70.6	20.5		
Total Organic Halides (TOX)	ug/l	31	16	17	15.2	63.9	19.5		
Total Organic Halides (TOX)	ug/l	21	15	19	-	60.8	21.1		
Total Organic Halides (TOX)	ug/l	29	24	14	-	68	22.2		
Total Organic Carbon	mg/l	17.8	7.7	15.2	1.4	77	76		
Total Organic Carbon	mg/l	14.2	7.6	8.3	1.4	76	75		
Total Organic Carbon	mg/l	12.6	6.9	13.1	-	76	75		
Total Organic Carbon	mg/l	11.9	6.6	8.9	-	74	75		
Specific Conductance	um/cm	464	415	472	526	457	520		
Specific Conductance	um/cm	466	417	473	-	522	520		
Specific Conductance	um/cm	465	412	470	-	521	530		
Specific Conductance	um/cm	471	415	473	-	537	530		
pH	std	7.92	8.1	7.63	7.7	7.3	7.4		
pH	std	8	8.09	7.68	-	7.3	7.4		
pH	std	8.01	8.09	7.73	-	7.3	7.4		
pH	std	8.02	8.09	7.97	-	7.3	7.4		
Gross Alpha	pCi/l	1.2	1	1	<2	-	-		
Gross Alpha	pCi/l	+/-1.9	+/-3	+/-4	-	-	-		

Footnotes: BMDL=Below Method Detection Limit ND=Parameter not detected '-'=Parameter not tested

ETC ENVIRONMENTAL TESTING and CERTIFICATION

DATA MANAGEMENT SUMMARY REPORT
(DM-1H) - History of All Parameters Present, Selected Sample Point

Chain of Custody Data Required for ETC Data Management Summary Report

See Below	MARATHON PETROLEUM COMPANY	MPCROBGMM	W N2-D	See Below
ETC Sample No.	Company	Facility	Sample Point	Date

Parameters	Units	Sample Points, Sampling Dates, and ETC Sample No.'s							
		W N2-D 820301 U0647	W N2-D 820510 U0648	W N2-D 820719 U0649	W N2-D 821109 B5824	W N2-D 830418 C0827	W N2-D 830620 C4578		
Gross Beta	pCi/l	7.8	-3	3	<6	-	-		
Gross Beta	pCi/l	+/-6.1	+/-4	+/-5	-	-	-		
Miscellaneous Parameters									
Radium 226	pCi/l	0	0.2	-.3	-	-	-		
Radium 226	pCi/l	+/-0.5	+/-0.4	+/-0.7	-	-	-		
Radium 228	pCi/l	0	-.2	0.6	-	-	-		
Radium 228	pCi/l	+/-9.3	+/-1	+/-1.6	-	-	-		
Temperature	Deg. C	11.1	14.4	16.7	15	-	-		

Footnotes: BMDL=Below Method Detection Limit ND=Parameter not detected '-'=Parameter not tested

DM-5

STUDENT'S-t TEST

BACKGROUND

Part 265 of regulations published on November 19, 1981 under the Resource Conservation and Recovery Act (RCRA) require the collection of groundwater monitoring data around hazardous waste landfills, surface impoundments and land treatment facilities. A minimum of one upgradient and three downgradient wells must be used in each monitoring system. The upgradient well must be capable of yielding representative background samples. The downgradient wells are to be located to detect any statistically significant amounts of hazardous waste migration.

During the first year, groundwater monitoring parameters which include drinking water indicators, groundwater quality, and groundwater contamination indicators, must be analyzed quarterly for all wells. For so-called indicator parameters (specific conductance, pH, total organic carbon and total organic halides), four replicate measurements are required from each sample taken from upgradient wells. All first year replicate measurements from the upgradient wells are to be pooled to calculate a mean background value for each of the four indicator parameters.

After background values are established, each well (up and downgradient) must be sampled at least semi-annually for the contamination indicator parameters and annually for the groundwater quality parameters. For each sample (from downgradient as well as upgradient wells) the arithmetic mean and variance must be calculated at least semi-annually for each indicator parameter based on at least four replicate measurements. The results must be compared with the initial (first year) background arithmetic mean. This comparison must be made for each well (up and downgraient) individually against the background values calculated from the pooled first year upgradient well data.

All comparisons must use the Student's t-Test at the 0.01 level of significance (i.e., 99% confidence) to determine statistically significant increases (and decreases in pH) over initial background.

CHOICE OF STATISTICAL FORMULA

The above requirements apply to facilities that are in the Interim Permit status under RCRA. Facilities with final RCRA permits are subject to similar monitoring requirements pursuant to 40 CFR Part 264, published June 26, 1982. However, the two regulations differ in the required level of confidence and in the degree of detail provided for the application of the Student's t-Test when evaluating the indicator data. The Permanent Status regulations call for a 0.05 level of significance (i.e., 95% confidence) compared to 0.01 level of confidence in the Interim Status regulations. In addition, the Permanent Status regulations specify the use of the Cochran's Approximation to the Behrens-Fisher Student's t-Test, whereas the Interim Status requirements are silent as to the particular version of the Student's t-Test that must be used. The Interim Status rules leave to the discretion of the facility owner or operator questions such as the comparison of data sets (i.e., first year pooled background data vs. second year individual well data) that have dissimilar variances.

Subsequent guidance from the U. S. Environmental Protection Agency suggests that the vagueness of the Interim Status Student's t requirements be resolved by adopting the Permanent Status version of the test, still applied, however, at the 0.01 level of confidence. Aside from providing needed answers in the applications of the Student's t-Test to Interim Status data, this approach allows for a useful preview of the results that can be expected after a facility obtains its final permit and begins to operate under the Permanent Status rules. The only adjustment required is to apply the test at the 0.05 level of confidence (Permanent Status) rather than the 0.01 level of confidence (Interim Status).

ETC APPROACH

ETC has chosen the Cochran's Approximation to the Behrens-Fisher approach in the routine Student's t comparisons that it makes for its groundwater monitoring clients. For interim status facilities the Cochran's Approximation to the Behrens-Fisher Student's t-Test will be applied at the 0.01 level of confidence. With each calculation, the "t" values for the 0.05 level of confidence will be provided as well. This not only satisfies the requirements for any facility with

a final permit but provides owners and operators of interim status facilities with a good indication of how the results of the test might change once they obtain a final permit.

The actual formula used in ETC's calculations is shown below. To assist in the interpretation of the information displayed in ETC's summary charts, the following explanations are provided:

1. Each ETC Student's t Report consists of two parts:

   - o Background Wells: This section summarizes the first year background data based on the upgradient wells. The well I.D.'s, ETC sample numbers and sample dates are listed. At the bottom of the page, the mean, variance and t-Table values at the 0.05 (95%) and 0.01 (99%) confidence levels are shown, as well as the coefficient of variation (an indication of normal distribution).

   - o Comparison Wells: This section shows for each well (including upgradient) the data fror each round of sampling and analysis plus the results from the Student's t comparison of this data with the background values discussed above.

2. The details of the calculations used to derive these summaries are shown in the attached excerpt from the Part 264 regulations and from the guidance issued in October, 1982 for Interim Status facilities. In summary the steps are:

   a. Calculate the background mean and variance using the pooled upgradient well data, and look up one-tailed T-table values (two-tailed for pH) at 0.05 and 0.01 levels of significance.

   b. For each well, use the current monitoring data to calculate, or look up, the same three values (i.e., mean, variance and t-table value);

   c. For each well and each indicator parameter, calculate the t* statistic using the means and variances derived in steps "a" and "b", above;

   d. For each well and each parameter, calculate the tc comparison using the variances and t-table values derived in steps "a" and "b" above;

   e. Using the t* and tc values from steps "c" and "d", determine if statistically significant increases (or decreases for pH) have occured in the indicator parameters. Specifically:

3. For each well in ETC's Well Comparison Summary, the following results are shown:

   a. The mean and variance of each parameter;

   b. The t* statistic from Step 2(c) above, calculated at the 0.05 and 0.01 significance levels (shown as 95% and 99%, respectively);

   c. the tc comparison statistic from Step 2(d), above.

4. For facilities in Interim Status, the relevant comparisons is between the tc (99%) and t* values. For facilities with final permits, the tc (95*) and t* values should be compared. In either case, ETC has used a double asterisk "**" symbol next to the tc values when either (95% or 99%) indicate a significant increase (or decrease for pH) over background values.

with, be decomposed by, or be ignited by the contained waste. Inside containers must be tightly and securely sealed. The inside containers must be of the size and type specified in the Department of Transportation (DOT) hazardous materials regulations (49 CFR Parts 173, 178, and 179), if those regulations specify a particular inside container for the waste.

(b) The inside containers must be overpacked in an open head DOT-specification metal shipping container (49 CFR Parts 178 and 179) of no more than 416-liter (110 gallon) capacity and surrounded by, at a minimum, a sufficient quantity of absorbent material to completely absorb all of the liquid contents of the inside containers. The metal outer container must be full after packing with inside containers and absorbent material.

(c) The absorbent material used must not be capable of reacting dangerously with, being decomposed by, or being ignited by the contents of the inside containers in accordance with § 264.17(b).

(d) Incompatible wastes, as defined in § 260.10 of this chapter, must not be placed in the same outside container.

(e) Reactive wastes, other than cyanide- or sulfide-bearing waste as defined in § 261.23(a)(5) of this chapter, must be treated or rendered non-reactive prior to packaging in accordance with paragraphs (a) through (d) of this section. Cyanide- and sulfide-bearing reactive waste may be packed in accordance with paragraphs (a) through (d) of this section without first being treated or rendered non-reactive.

§§ 264.317-264.339 [Reserved]

13. 40 CFR Part 264 is amended by adding Appendix IV to read as follows:

Appendix IV

Cochran's Approximation to the Behrens-Fisher Students' t-test

Using all the available background data (n_a readings), calculate the background mean ($\bar{X}_a$) and background variance (s_a^2). For the single monitoring well under investigation (n_m reading), calculate the monitoring mean ($\bar{X}_m$) and monitoring variance (s_m^2).

For any set of data ($X_1, X_2 \ldots X_n$) the mean is calculated by:

$$\bar{X}_n = \frac{X_1 + X_2 \ldots + X_n}{n}$$

and the variance is calculated by:

$$s^2_n = \frac{(X_1 - \bar{X})^2 + (X_2 - \bar{X})^2 \ldots + (X_n - \bar{X})^2}{n-1}$$

where "n" denotes the number of observations in the set of data.

The t-test uses these data summary measures to calculate a t-statistic (t^*) and a comparison t-statistic (t_c). The t^* value is compared to the t_c value and a conclusion reached as to whether there has been a statistically significant change in any indicator parameter.

The t-statistic for all parameters except pH and similar monitoring parameters is:

$$t^* = \frac{\bar{X}_m - \bar{X}_a}{\sqrt{\frac{s_m^2}{n_m} + \frac{s_a^2}{n_a}}}$$

If the value of this t-statistic is negative then there is no significant difference between the monitoring data and background data. It should be noted that significantly small negative values may be indicative of a failure of the assumption made for test validity or errors have been made in collecting the background data.

The t-statistic (t_c), against which t^* will be compared, necessitates finding t_a and t_m from standard (one-tailed) tables where,

t_a = t-tables with ($n_a - 1$) degrees of freedom, at the 0.05 level of significance.

t_m = t-tables with ($n_m - 1$) degrees of freedom, at the 0.05 level of significance.

Finally, the special weightings W_a and W_m are defined as:

$$W_a = \frac{s_a^2}{n_a} \quad \text{and} \quad W_m = \frac{s_m^2}{n_m}$$

and so the comparison t-statistic is:

$$t_c = \frac{W_a t_a + W_m t_m}{W_a + W_m}$$

The t-statistic (t^*) is now compared with the comparison t-statistic (t_c) using the following decision-rule:

If t^* is equal to or larger than t_c then conclude that there most likely *has been a significant increase* in this specific parameter.

If *t^* is less than t_c* then conclude that most likely *there has not been a change* in this specific parameter.

The t-statistic for testing pH and similar monitoring parameters is constructed in the same manner as previously described except the negative sign (if any) is discarded and the caveat concerning the negative value is ignored. The standard (two-tailed) tables are used in the construction t_c for pH and similar monitoring parameters.

If t^* is equal to or larger than t_c, then conclude that there most likely *has been a significant increase* (if the initial t^* had been negative, this would imply a significant decrease). If t^* is less than t_c, then conclude that there most likely has been no change.

A further discussion of the test may be found in *Statistical Methods* (6th Edition, Section 4.14) by G. W. Snedecor and W. G. Cochran, or *Principles and Procedures of Statistics* (1st Edition, Section 5.8) by R. G. D. Steel and J. H. Torrie.

STANDARD T-TABLES 0.05 LEVEL OF SIGNIFICANCE

Degrees of freedom	[illegible] (one-tailed)	[illegible] (two-tailed)
1	6.314	12.706
2	2.920	4.303
3	2.353	3.182
4	2.132	2.776
5	2.015	2.571
6	1.943	2.447
7	1.895	2.365
8	1.860	2.306
9	1.833	2.262
10	1.812	2.228
11	1.796	2.201
12	1.782	2.179
13	1.771	2.160
14	1.761	2.145
15	1.753	2.131
16	1.746	2.120
17	1.740	2.110
18	1.734	2.101
19	1.729	2.093
20	1.725	2.086
21	1.721	2.080
22	1.717	2.074
23	1.714	2.069
24	1.711	2.064
25	1.708	2.060
30	1.697	2.042
40	1.684	2.021

Adapted from Table III of "Statistical Tables for Biological, Agricultural, and Medical Research" (1947), R. A. Fisher and F. Yates.

PART 265—INTERIM STATUS STANDARDS FOR OWNERS AND OPERATORS OF HAZARDOUS WASTE TREATMENT, STORAGE, AND DISPOSAL FACILITIES

14. The authority citation for Part 265 reads as follows:

Authority: Sections 1008, 2002(a), and 3004 of the Solid Waste Disposal Act, as amended by the Resource Conservation and Recovery Act of 1976, as amended (42 U.S.C. 6905, 6912(a), and 6924).

15. In 40 CFR 265, Subpart L, § 265.253 is amended by revising paragraph (a) and removing paragraph (c), and § 265.258 is added to read as follows:

§ 265.253 Containment.

If leachate or run-off from a pile is a hazardous waste, then either:

(a)(1) The pile must be placed on an impermeable base that is compatible with the waste under the conditions of treatment or storage;

(2) The owner or operator must design, construct, operate, and maintain a run-on control system capable of preventing flow onto the active portion of the pile during peak discharge from at least a 25-year storm;

ETC ENVIRONMENTAL TESTING and CERTIFICATION

DATA MANAGEMENT SUMMARY REPORT

(DM-5H) - Students' T-test for Significant Groundwater Variation (Background Wells)

Chain of Custody Data Required for ETC Data Management Summary Report

See Below (ETC Sample No.) | MARATHON PETROLEUM COMPANY (Company) | MPCROBGUM (Facility) | See Below (Sample Point / Date)

Client Sample Point	Client Sample Date	ETC Sample Number	Parameters and Units: pH Std	Total Organic Halides (TOX) ug/l	Total Organic Carbon (TOC) mg/l	Specific Conductance umhos/cm
W B2-U	820301	U0636	8.19	44.00	15.20	356.00
W B2-U	820301	U0636	8.20	39.00	15.40	355.00
W B2-U	820301	U0636	8.20	55.00	13.30	355.00
W B2-U	820301	U0636	8.10	53.00	13.50	356.00
W B2-U	820510	U0637	8.12	43.00	5.70	433.00
W B2-U	820510	U0637	8.17	35.00	6.40	434.00
W B2-U	820510	U0637	8.15	31.00	6.40	427.00
W B2-U	820510	U0637	8.18	40.00	7.80	435.00
W B2-U	820719	U0638	8.13	41.00	23.70	481.00
W B2-U	820719	U0638	8.07	40.00	23.40	481.00
W B2-U	820719	U0638	8.08	42.00	21.70	483.00
W B2-U	820719	U0638	8.04	41.00	20.00	480.00
W B2-U	821109	B5823	7.80	16.20	1.80	413.00
W B2-U	821109	B5823		19.60	1.80	
Background Statistics:						
Number of Observations:			13	14	14	13
Mean:			8.11	38.56	12.58	422.23
Variance:			.01	114.27	59.55	2689.69
Coefficient of Variation:			.01	.28	.61	.12
T-table Value (95%):			2.18	1.77	1.77	1.78
T-table Value (99%):			3.05	2.65	2.65	2.68

Footnotes: "/" = value not used "+" = Non-normal distribution

ETC ENVIRONMENTAL TESTING and CERTIFICATION

DATA MANAGEMENT SUMMARY REPORT

(DM-5H) - Students' T-test for Significant Groundwater Variation (Comparison Wells)

Chain of Custody Data Required for ETC Data Management Summary Report

ETC Sample No.	Company	Facility	Sample Point	Date
See Below	MARATHON PETROLEUM COMPANY	MPCROBGWM	See Below	

Client Sample Point	Client Sample Date	ETC Sample Number	pH Std	Total Organic Halides (TOX) ug/l	Total Organic Carbon (TOC) mg/l	Specific Conductance umhos/cm
			Parameters and Units			
W B1-D	830418	C0822	7.30	83.90	71.00	456.00
W B1-D	830418	C0822	7.30	79.40	69.00	456.00
W B1-D	830418	C0822	7.30	80.80	69.00	455.00
W B1-D	830418	C0822	7.30	81.20	70.00	456.00
Number of Observations:			4	4	4	4
Mean:			7.30	81.32	69.75	455.75
Variance:			.00	3.54	.92	.25
T-table Value (99%):			5.84	4.54	4.54	4.54
T-table Value (95%):			3.18	2.35	2.35	2.35
T*:			27.35	14.22	27.00	2.33
Tc (99%-40CFR Part 265):			3.05 **	2.84 **	2.75 **	2.68
Tc (95%-40CFR Part 264):			2.18 **	1.83 **	1.80 **	1.78 **
W B1-D	830620	C4573	7.10	44.40	74.00	530.00
W B1-D	830620	C4573	7.10	31.40	72.00	530.00
W B1-D	830620	C4573	7.10	38.70	73.00	530.00
W B1-D	830620	C4573	7.10	30.30	73.00	530.00
Number of Observations:			4	4	4	4
Mean:			7.10	36.20	73.00	530.00
Variance:			.00	43.78	.67	.00
T-table Value (99%):			5.84	4.54	4.54	4.54
T-table Value (95%):			3.18	2.35	2.35	2.35
T*:			34.11	-.54	28.74	7.49
Tc (99%-40CFR Part 265):			3.05 **	3.73	2.72 **	2.68 **
Tc (95%-40CFR Part 264):			2.18 **	2.10	1.79 **	1.78 **
W B2-U	830418	C0823	7.60	49.50	28.00	420.00
W B2-U	830418	C0823	7.60	57.60	32.00	420.00
W B2-U	830418	C0823	7.60	53.70	31.00	420.00
W B2-U	830418	C0823	7.60	53.30	32.00	419.00
Number of Observations:			4	4	4	4
Mean:			7.60	53.53	30.75	419.75
Variance:			.00	10.96	3.58	.25
T-table Value (99%):			5.84	4.54	4.54	4.54
T-table Value (95%):			3.18	2.35	2.35	2.35
T*:			17.22	4.53	8.01	-.17
Tc (99%-40CFR Part 265):			3.05 **	3.13 **	2.98 **	2.68
Tc (95%-40CFR Part 264):			2.18 **	1.92 **	1.87 **	1.78
W B2-U	830620	C4574	7.50	62.00	54.00	410.00
W B2-U	830620	C4574	7.50	53.00	54.00	410.00
W B2-U	830620	C4574	7.50	87.00	54.00	410.00
W B2-U	830620	C4574	7.50	72.00	54.00	410.00
Number of Observations:			4	4	4	4
Mean:			7.50	68.50	54.00	410.00
Variance:			.00	212.33	.00	.00
T-table Value (99%):			5.84	4.54	4.54	4.54
T-table Value (95%):			3.18	2.35	2.35	2.35
T*:			20.60	3.83	20.08	-.85
Tc (99%-40CFR Part 265):			3.05 **	4.29	2.65 **	2.68
Tc (95%-40CFR Part 264):			2.18 **	2.28 **	1.77 **	1.78
Background Statistics:						
Number of Observations:			13	14	14	13
Mean:			8.11	38.56	12.58	422.23
Variance:			.01	114.27	59.55	2689.69
Coefficient of Variation:			.01	.28	.61	.12
T-table Value (95%):			2.18	1.77	1.77	1.78
T-table Value (99%):			3.05	2.65	2.65	2.68

* = Value not used # = Non-normal Distribution //// = Not enough data ** = Significant Change

DATA MANAGEMENT SUMMARY REPORT

(DM-5H) - Students' T-test for Significant Groundwater Variation (Comparison Wells)

Chain of Custody Data Required for ETC Data Management Summary Report

ETC Sample No.	Company	Facility	Sample Point	Date
See Below	MARATHON PETROLEUM COMPANY	MPCROBGWM	See Below	

Client Sample Point	Client Sample Date	ETC Sample Number	pH Std	Total Organic Halides (TOX) ug/l	Total Organic Carbon (TOC) mg/l	Specific Conductance umhos/cm
W B4-D	830418	C0825	7.30	23.40	63.00	552.00
W B4-D	830418	C0825	7.30	23.10	58.00	554.00
W B4-D	830418	C0825	7.30	29.80	62.00	565.00
W B4-D	830418	C0825	7.30	31.70	54.00	564.00
Number of Observations:			4	4	4	4
Mean:			7.30	27.00	59.25	558.75
Variance:			.00	19.37	16.92	44.92
T-table Value (99%):			5.84	4.54	4.54	4.54
T-table Value (95%):			3.18	2.35	2.35	2.35
T*:			27.35	-3.20	16.02	9.24
Tc (99%-40CFR Part 265):			3.05 **	3.35	3.59 **	2.78 **
Tc (95%-40CFR Part 264):			2.18 **	1.99	2.06 **	1.81 **
W B4-D	830620	C4577	7.80	28.00	86.00	550.00
W B4-D	830620	C4577	7.80	26.20	84.00	560.00
W B4-D	830620	C4577	7.80	24.90	84.00	560.00
W B4-D	830620	C4577	7.80	24.30	79.00	570.00
Number of Observations:			4	4	4	4
Mean:			7.80	25.85	83.25	560.00
Variance:			.00	2.68	8.92	66.67
T-table Value (99%):			5.84	4.54	4.54	4.54
T-table Value (95%):			3.18	2.35	2.35	2.35
T*:			10.47	-4.28	27.76	9.21
Tc (99%-40CFR Part 265):			3.05 **	2.79	3.30 **	2.82 **
Tc (95%-40CFR Part 264):			2.18 **	1.82	1.97 **	1.82 **
W N1-D	830418	C0826	7.20	20.50	80.00	725.00
W N1-D	830418	C0826	7.20	27.40	88.00	727.00
W N1-D	830418	C0826	7.30	29.30	79.00	741.00
W N1-D	830418	C0826	7.30	26.00	70.00	737.00
Number of Observations:			4	4	4	4
Mean:			7.25	25.80	79.25	732.50
Variance:			.00	14.31	54.25	59.67
T-table Value (99%):			5.84	4.54	4.54	4.54
T-table Value (95%):			3.18	2.35	2.35	2.35
T*:			20.80	-3.72	15.80	20.83
Tc (99%-40CFR Part 265):			4.41 **	3.23	4.09 **	2.81 **
Tc (95%-40CFR Part 264):			2.67 **	1.95	2.21 **	1.82 **
W N1-D	830620	C4576	7.60	43.00	94.00	700.00
W N1-D	830620	C4576	7.60	44.00	93.00	700.00
W N1-D	830620	C4576	7.60	29.00	93.00	710.00
W N1-D	830620	C4576	7.60	37.00	93.00	710.00
Number of Observations:			4	4	4	4
Mean:			7.60	38.25	93.25	705.00
Variance:			.00	47.58	.25	33.33
T-table Value (99%):			5.84	4.54	4.54	4.54
T-table Value (95%):			3.18	2.35	2.35	2.35
T*:			17.22	-.07	38.83	19.27
Tc (99%-40CFR Part 265):			3.05 **	3.77	2.68 **	2.75 **
Tc (95%-40CFR Part 264):			2.18 **	2.12	1.78 **	1.80 **
Background Statistics:						
Number of Observations:			13	14	14	13
Mean:			8.11	38.56	12.58	422.23
Variance:			.01	114.27	59.55	2689.69
Coefficient of Variation:			.01	.28	.61	.12
T-table Value (95%)			2.18	1.77	1.77	1.78
T-table Value (99%)			3.05	2.65	2.65	2.68

'*'=Value not used '+'=Non-normal Distribution '/////'=Not enough data '**'=Significant Change

DATA MANAGEMENT SUMMARY REPORT

(DM-5H) - Students' T-test for Significant Groundwater Variation (Comparison Wells)

Chain of Custody Data Required for ETC Data Management Summary Report

See Below (ETC Sample No.) | MARATHON PETROLEUM COMPANY (Company) | MPCROBGWM (Facility) | See Below (Sample Point / Date)

Client Sample Point	Client Sample Date	ETC Sample Number	pH Std	Total Organic Halides (TOX) ug/l	Total Organic Carbon (TOC) mg/l	Specific Conductance umhos/cm
			Parameters and Units			
W N2-D	830418	C0827	7.30	70.60	77.00	457.00
W N2-D	830418	C0827	7.30	63.90	76.00	522.00
W N2-D	830418	C0827	7.30	60.80	76.00	521.00
W N2-D	830418	C0827	7.30	68.00	74.00	537.00
Number of Observations:			4	4	4	4
Mean:			7.30	65.83	75.75	509.25
Variance:			.00	18.83	1.58	1266.92
T-table Value (99%):			5.84	4.54	4.54	4.54
T-table Value (95%):			3.18	2.35	2.35	2.35
T*:			27.35	7.60	29.30	3.80
Tc (99%-40CFR Part 265):			3.05 **	3.34 **	2.81 **	3.81
Tc (95%-40CFR Part 264):			2.18 **	1.98 **	1.82 **	2.13 **
W N2-D	830620	C4578	7.40	20.50	76.00	520.00
W N2-D	830620	C4578	7.40	19.50	75.00	520.00
W N2-D	830620	C4578	7.40	21.10	75.00	530.00
W N2-D	830620	C4578	7.40	22.20	75.00	530.00
Number of Observations:			4	4	4	4
Mean:			7.40	20.83	75.25	525.00
Variance:			.00	1.28	.25	33.33
T-table Value (99%):			5.84	4.54	4.54	4.54
T-table Value (95%):			3.18	2.35	2.35	2.35
T*:			23.98	-6.09	30.17	7.01
Tc (99%-40CFR Part 265):			3.05 **	2.72	2.68 **	2.75 **
Tc (95%-40CFR Part 264):			2.18 **	1.79	1.78 **	1.80 **
Background Statistics:						
Number of Observations:			13	14	14	13
Mean:			8.11	38.56	12.58	422.23
Variance:			.01	114.27	59.55	2689.69
Coefficient of Variation:			.01	.28	.61	.12
T-table Value (95%):			2.18	1.77	1.77	1.78
T-table Value (99%):			3.05	2.65	2.65	2.68

"*" = Value not used in Non-normal Distribution "////" = Not enough data "**" = Significant Change